Letter to the editor

Radiation Sensitivity of *Escherichia coli* JM109 and DH5α

Determination of inactivation kinetics for foodborne pathogens, as presented in scientific manuscripts, is an important process for scientists, the food processing industry, and government agencies in making decisions on future research, adoption of new processing technologies, and the formulation of law and policies. Food scientists typically use multiple strain cocktails of limited homozogosity (increase genetic heterogeneity), and of the microorganisms of interest in their studies. At the very least well characterized single isolates, usually an outbreak-related strain, are used for determination of inactivation kinetics. Genetically engineered isolates of foodborne pathogens, hopefully isogenic to their wild-type counterparts, are typically used for determination of survival mechanism for various intervention technologies. Guidelines, including the identification of factors that influence reproducibility of resistance characteristics for test strains as well as the use of multi-isolate cocktails, as opposed to single strains, for determination of microbial inactivation kinetics have been outlined by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF 2006).

In the September 2007 issue of the *Journal of Food Science*, Chalise and others (2007) reported the use of a novel pulsed low energy electron-beam for inactivation of the *E. coli* K-12 strain on the surfaces of agar plates, and obtained D-10 values considerably lower than radiation D-10 values typically obtained for *E. coli*. As authors indicated in the Materials and Methods portion of the article, the antimicrobial efficacy of the novel pulsed e-beam was unknown at the time of research; and therefore, the objective was to determine whether or not this technique would inactivate radio-sensitive *E. coli* at all, as assessed by the D-10 value. Reported D-10 values were considerably lower than radiation D-10 values typically obtained for *E. coli* using high energy electron-beam or gamma radiation. The authors concluded that the extremely low D-10 values that were obtained were most likely due to the unique nature of the pulsed electron-beam unit that was utilized.

In this manuscript the genotype of *E. coli* JM109 (*recA*1, *endA*1, *gyrA*96, *thi*, *hsdR*17, *supE*44, *relA*1, Δ(*lac-proAB*)/F' [*traD*36, *proAB*$^+$, *lacI*^{q}, *lacZ*ΔM15]) was not listed in the Materials and Methods portion of the manuscript, an unintentional oversight. *E. coli* JM109, which is typically used in the field of recombinant DNA technology for cloning purposes and maintenance of multiple copies of plasmid-borne exogenous DNAs, carries deletions of both the *recA* and *gyrA* genes that are required for efficient recombination and replication of DNAs, and are overly sensitive to ionizing and ultraviolet radiation and genotoxic chemicals. Use of JM109 for evaluation of the new low energy pulse electron-beam apparatus as reported by Chalise and others (2007) was clearly inadvertent, as they were not fully aware of the extensive genetic modification of *E. coli* JM109. The authors plan to conduct microbial challenge studies using *E. coli* O157:H7 (ATCC 35150 or 43895) in stationary phase and inoculated in various food matrices (or adsorbed onto a surface) and subjected to the new pulsed e-beam technique, contingent on funding.

In the upcoming March issue of the *Journal of Food Science*, C.H. Sommers and K.T. Rajkowski (2007) compare the radiation sensitivity of 4 *Escherichia coli* strains to gamma (Cs-137) radiation. Two of these strains, *E. coli* O157:H7 C9490 and ATCC 35150, have been used in a number of studies in the field of food irradiation for determination of inactivation kinetics and growth kinetics in food matrices. The other 2 isolates were JM109 and DH5α, typically used for recombinant DNA technology, which carry mutations in the *recA* and *gyrA* genes. In the Sommers and Rajkowski study, *E. coli* JM109 and DH5α were found to be 3.74 to 5.02 times more radiation sensitive than the *E. coli* O157:H7 strains when suspended in Butterfield's Phosphate Buffer and irradiated at a temperature of 4 °C, indicating they are not suitable for use in the field of food irradiation or for evaluation of novel radiation processing equipment.

It should be noted that this is not a commentary or criticism of the description of the low energy electron-beam apparatus as described in the article by Chalise and others (2007). The dose rate for gamma radiation is typically much slower than for that of conventional high-energy e-beam, while the current density for the conventional e-beam is considerably lower than for the new pulsed e-beam. The study by Sommers and Rajkowski (2007), which will appear in the March 2008 issue of the *Journal of Food Science*, is a report on the extreme radiation sensitivity of the *E .coli* JM109 and DH5α versus that of *E. coli* O157:H7 isolates C9490 and ATCC 35150, conducted under tightly controlled experimental conditions. This study emphasizes the importance of the requisite criteria parameters for establishing the equivalence of alternative methods of food pasteurization as published by the National Advisory Committee on Microbiological Criteria for Foods (2006).

Sincerely,

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References

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Sommers CH, Rajkowski KT. 2007. Inactivation of *Escherichia coli* JM109, DH5α and O157:H7 Suspended in Butterfields Phosphate Buffer by Gamma Irradiation. J Food Sci (Forthcoming).